PATENT SPECIFICATION (11) 1 435 525

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(21) Application No. 34057/73 (22) Filed 17 July 1973 (19)

(31) Convention Application Nos. 9589 (32) Filed 18 July 1972

9372 9 March 1973 in

(33) Italy (IT)

(44) Complete Specification published 12 May 1976

(51) INT. CL.² B65H 19/22

(52) Index at acceptance

B8R 8A2 8A4

(54) WINDING DEVICE FOR PAPER WEBS OR THE LIKE

(71) I, FABIO PERINI, an Italian citizen of Palazzo Giusti, S. Marco, Lucca, Italy,

do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be per-

shortly during the separation stage of a completed roll and of introduction of a new core.

According to a further embodiment the movable roller or pressing unit is accele-

ERRATUM

SPECIFICATION NO 1435525

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THE PATENT OFFICE
13 October 1976

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to be driven at a peripheral speed equal to the feed speed of the web to be wound; a second cylinder spaced from the first cylinder by an amount corresponding to the diameter of the winding cores onto which the webs are to be wound, said second cylinder being adapted to be driven at a peripheral speed equal to that of the first cylinder during winding of the webs into rolls, and at a lower speed during the core replacement stage; means to insert a core between said two cylinders, a roller adapted to rotate in contact with the roll being wound so as to retain the same in contact with the first and second cylinders, and means for driving the said roller during the separation stage of the completed roll at a peripheral speed different from the feed speed to cause the completed roll to roll on one of the cylinders and separate from the other.

Said roller may be carried by oscillating arms in such a manner as to be moved with the progressive increase of the diameter of the roll being formed, and may fall back into an initial stopping position after the separation of the completed roll.

According to one form of the invention, said roller is driven with a peripheral speed equal to that of the material feed during the winding stage is slowed down or braked

the winding of the material fed thereto;

Figs. 8 and 9 illustrate respectively a detail in a view taken along the line VIII—VIII of Fig. 1 and in an enlarged section taken along the line IX—IX of Fig. 8;

Fig. 10 illustrates an overall view of a modified form of machine in a vertical section taken along a plane perpendicular to the axis of the cylinders and cores;

Figs. 11 and 12 illustrate details of Fig. 10 in two different stages of the winding of a reel onto a tubular core and of replacement of a tubular core.

According to Figs. 1 to 9 of the accompanying drawing, 1 denotes a cylinder which is designed to feed the material to a roll or reel being wound. The material arrives according to the arrow $f1$ of Fig. 1 and its course is denoted by the line M. Said material passes between a pair of feed rolls 3 which are in particular embossing cylinders, and is forwarded over rollers 5, 7 and 9, the latter being a tensioning roller. At least the roller 9 may be rotationally driven at the feed speed set by the peripheral speeds of the rolls 3 and of the cylinder 1. The cylinder 1 has a plurality of deep annular grooves 1A (also see Fig. 8) into which toothed belts 11 and respective supporting

arms 13 extend, said arms 13 being carried by a structure 15 (also see Fig. 9). Said belts 11 form a conveyor.

A main drive shaft 17 drives by belts or chains shown dotted in Fig. 1 the embossing feed rolls 3, the rollers 7 and 9 the cylinder 1 and through the latter the toothed belts 11. All these components are driven to obtain a peripheral speed corresponding to the speed of the fed material, except that the speed of the belts 11 is lower. The belts 11 project slightly from the surface of the cylinder 1, as indicated in Fig. 9.

Reference numeral 19 indicates a drive from the shaft 17 to a speed reducer unit 21, including a suitable clutch arrangement so as to drive a drive belt 23 selectively at two speeds differing somewhat from each other, for instance by about 3% or 4%. The drive belt 23, is in driving engagement with a second cylinder 25 to drive the same in its higher speed mode at a running speed corresponding to the peripheral speed of the cylinder 1 and to feed speed of the paper web material, which at the lower speed of the belt 23, the cylinder 25 assumes a lower peripheral speed, for instance, approximately 3—4% lower than the peripheral speed of the cylinder 1. Such fine adjustment of the peripheral speed of the cylinder 25 (with respect to that of the cylinder 1) serves to adjust the tightness of the winding of the reels.

27 denotes a drive from the drive shaft 17 to a braking unit 29, which may alternatively drive a second flexible drive 31 or may determine a short stopping period or at least a deceleration period of said drive 31. 33 denotes an arm movable and stressed through a cylinder-piston system 35, said arm 33 being movable about a shaft 37 and said arm carrying at the movable end a roller 39 having its axis parallel to those of the cylinders 25 and 1. The drive 31 drives a transmission shaft coaxial with the shaft 37 of the arm 33; this transmission shaft, through a drive 41, drives the roller 39 in rotation. The drives 27, 31, and 41 are such that the roller 39 is driven with a peripheral speed corresponding to that of the cylinders 1 and 25 unless the brake 29 is applied.

43 denotes a reservoir chute for the tubular cores to be fed to the winding machine and, in particular, to be fed between the two cylinders 1 and 25, the cores being in general of cardboard or the like and an internal reinforcement mandrel is not required. Said cores are denoted by B and they are retained as a column in the reservoir chute 43 by means of a device which allows the delivery thereof one at a time as it is possible to see particularly by comparing Figs. 5 and 6. In particular, said device includes a cylinder-piston control system 45 which acts on two pairs of retaining teeth 47 and 49 to insert and withdraw them from the reservoir chute in a predetermined sequence. The retaining teeth 47, under the normal winding conditions, retain the column of cores B by holding the lowermost core BO while the teeth 49 are retracted as in Figs. 3, 4 and 5. When the core BO is to be fed, control 45 actuates the retaining teeth 49 into the position projecting in the reservoir chute 43, so as to retain the core B_3 (Figs. 5 and 6). The retaining teeth 47 are then withdrawn to release the core BO (Fig. 6) towards the portion B1 of Fig. 4.

The reservoir chute 43 is formed with lower lateral retaining saddles 43A having forward extensions 43B substantially tangential to but stopping short of the cylinder 1. Parallel with extensions 43B, there are also guides 51 for a carriage 53 adapted to thrust cores from the position B1 into engagement into the cylinders 1 and 25. The core falls down the reservoir chute 43 and the position B1, where it is retained by the saddles 43A and extensions 43B. The carriage 53 (see especially Figs. 2 to 7) has a thrust surface 53A making an acute angle with the extensions 43B. The carriage 53 has a reciprocal motion in the guides 51, being actuated by a crank 55 linked to an eccentric of a disc 57, which itself is driven by the shaft 17 during the insertion cycle.

As an additional functional member of the machine, a guide surface 59 is provided arranged above the active upper run of the belts 11 and spaced therefrom by an amount of slightly less than the unstressed diameter of the fully wound reel which is to be moved away. Such surface 59 may be fixed in position and/or elastically urged towards the belts 11.

The machine also includes other per se known members which do not form part of the present invention. Among these, there are blade cylinders 61 and 63 designed to effect a perforation across the entire width of the advancing web at a fixed horizontal spacing.

The operation of the machine is the following.

The cores B are selectively delivered from the reservoir chute 43 by action of the retaining members 47 and 49, and the carriage 53 is advanced from the position of Figs. 2 to 4 into the position of Fig. 5, wherein it shifts the core from the position indicated by B1 to the position B7 between the cylinder 1 and the cylinder 25 with a slight forcing. The carriage thrust surface 53A active wall is inclined with respect to the plane containing the axes of the cylinders 1 and 25 and faces towards the cylinder 1, so that it tends to press the core B7 towards the cylinder 1. From the instant when the core B (Figs. 3 and 4) has been brought by the carriage 53 into the position

B6 shown in Fig. 5, subsequent movements are all effected by the cylinders 1 and 25 and by the roller 39. Under the conditions of Fig. 5 the cylinder 25 rotates with a peripheral speed slightly lower than the peripheral speed of the cylinder 1, and thus the core B tends to roll on the cylinder 25, going from the position B6 of Fig. 5 into the position B_3 of Fig. 6. In this position B_3, the core winds the material the winding being initiated pneumatically as will be described hereafter. When the forming reel is separated in a manner to be described hereafter, the core in the position B_3 begins the winding, moving into the position B_4 shown in Fig. 3, wherein the material wound on it contacts the cylinders 1 and 25 and the roller 39. The roller 39 is lowered onto the reel along a circular path T_{37} centred on the axis of the shaft 37, that is on the axis of the arm 33 carrying the roller 39. Under these conditions (Figs. 3 and 4) the members 1, 25 and 39 rotate with substantially equal peripheral speeds until the increasing diameter reel is fully formed, this determining a gradual movement of the reel from the position B_3 of Fig. 6 to the position B_4 of Fig. 3 and to the position B_5 of Fig. 4 and of Fig. 5, with a corresponding movement of the roller 39. At this point, the winding of the material on the reel being completed, the changes of relative speed of the members 25 and 39 take place and in this way the replacement of the core and the moving away of the formed reel or stick take place. In particular, under the conditions of Fig. 5, there occurs a small but significant reduction of peripheral speed (3—4%) of the cylinder 25 with respect to the cylinder 1, to obtain the advance of the new core from the position B7 into the position B_3; simultaneously under the conditions of Fig. 5 a short stopping or at least a slowdown occurs owing to the braking of the roller 39, which determines a rolling round the roller 39 of the reel formed on the core around the roller 39, and thus the reel moves onto the conveyor represented by the belts 11, the reel being then spaced from the cylinder 25; the reel thus reaches the position denoted by B_6 in Figs. 6 and 7 to then reach subsequent positions such as that B_8 (Fig. 3) with a rolling along the guide surfaces 59 by action of the belts 11. Under the conditions shown in Figs. 6 and 7, the reel in the position B_6 has reduced its own peripheral speed of rotation owing to the lower speed of the belts 11 with which it is in contact. While the core in the position B_3 assumes the advancing or feed speed of the material, and thus the tangential speed corresponding to that of the cylinder 1. At this point, i.e. under the conditions of Fig. 6, an assembly of air nozzles 70 come into play. The nozzles are arranged for instance within the grooves 1A of the cylinder 1 with an orientation towards the cylinder 25 and thus towards the inter-space between the core position B_3 and the reel in position B_6 as shown in the array of Fig. 6. Air blown through the nozzles 70 forms loop M_2 in the material (Fig. 6) between the core position B_3 and the completed reel in the position B_6, owing to the reduced peripheral speed of this latter (in this stage) with respect to the speed of the fed material, the loop M_2 is eventually caught between the core in the position B_3 and the cylinder 25, which leads to the tearing of the paper web material at some point between the contact zone between the core in position B_3 and the cylinder 25 and the reel in position B_6. In practice, the tearing may take place at the position of perforations in the web. The material thus begins the winding on the core at position B_3, and proceeds continuously through the stages of the partial reel at position B_4, the position B_5, to the separation of the complete reel at position B_6 whence it proceeds to the position B_8 in Fig. 3. The roller 39 is lowered onto each successive reel being formed at the position B_4. The material is continuously fed while the winding goes through these various stages.

Figures 10 and 12 show an apparatus largely similar to that of Figs. 1 to 9 but having a different layout. The material to be wound follows a path M_x in a direction indicated by an arrow f_{12} round a cylinder 71 rotating in the direction of the arrow f_{10} with its peripheral speed equal to the feed speed of the material. A cylinder 73 located below and spaced from the cylinder 71 is adapted to be driven in the direction of arrow f_{14} either at the peripheral speed of cylinder 71 or at a speed slightly reduced with respect to that speed. The drive for this is disclosed in some detail with reference to cylinder 25 of Figs. 1 and 9.

A reservoir chute for cores B is shown at 79 and is associated with retaining members 81 and 83 and a feed carriage 85 with a thrust surface 85A operating in similar manner to the corresponding parts described with reference to Figs. 1 to 9 to feed the cores B seriatim from the chute 79 to a position between the cylinders 71 and 73 and indicated at B10 in Fig. 11.

In order to allow the positioning of the core at the position B_{10} (in alignment with the axes of the cylinders 71 and 73) the cylinder 73 is run for a short period at a lower speed whereby the core rolls in the direction of the arrow f_{16} around the cylinder 73, driven by the cylinder 71.

A roller or pressing unit 97 rotatable in the direction of an f_{18} has a two speed drive similar to the drive to the roller 39 of Figs. 1 to 9. The lower of the two peripheral speeds of the roller 97 corresponding to the

peripheral speed of the roller 31 at the feed speed of the material being fed. The higher peripheral speed is 3% to 4% above this speed.

Between the roller 97 and the cylinder 71 there is located a set of nozzles 103, arranged on a line parallel with the axes of the cylinder 71 and the roller 97, to blow towards the cylinder 73. A second set of nozzles 105 is arranged adjacent the cylinder 73 so as to direct a blowing towards the tubular core located in the position B_{10} and towards the cylinder 71. Owing to the arrangement of the cylinders as described and the trend of the material which arrives from above on the path M_x, the sets of nozzles 103 and 105 may be replaced by slit-like continuous nozzles so as to act on the material substantially uniformly in the transverse direction.

The operation of the winding device now described is the following: during the winding of the material on the core in the position B_{12} (see Fig. 12) the reel being formed is in contact with the cylinder 71, the cylinder 73 and the roller 97, and the roller or pressing unit 97 tends to rise gradually as the reel being formed increases its diameter. When the reel has reached a desired diameter or when a desired length of the material has been wound, the reel then being in the position indicated by B_{14} in Fig. 10, the replacement of the reel takes place. For this purpose the cylinder 73 reverts to its lower speed while the thrust carriage 85 carries a new tubular core towards the position B_{10}. Simultaneously, the roller 97 is temporarily accelerated to the higher speed to bring about an advance of the completed reel from the position B_{14} of Fig. 10 to the position B_{16} of Fig. 11 and subsequent motion in the direction of the arrow f20 by rolling of said reel B_{16} first on the cylinder 73 and subsequently on supporting surface 107 which starts up substantially tangential to the cylinder 73. The temporary reduction of speed of the cylinder 73 for the insertion of the new tubular core assists the separation of the complete reel B_{16} in the direction of the arrow *f*20, owing to the increased difference of peripheral speed between the accelerated roller 97 and the slowed down cylinder 73. The separation of the completed reel B_{16} leads to tearing of the material strip between the contact zone of the cylinder 71 with the newly inserted reel at position B_{10}, and the contact zone between the roller 97 and the reel B_{16} being separated. Within this length there is normally a single transverse perforation line. The blowing of the nozzle 103 facilitates this breakdown and this blowing also aids the insertion of the end M_y of the material between the tubular core in the position B_{10} and the cylinder 73, as indicated in Fig. 11. Subsequently, when said end M_y, winding up on the core has passed the contact line between the cylinder 73 and the reel, the blast of the nozzle 105 acts on said end (indicated now with a dotted line and with the reference M_z) in order to facilitate the insertion of said end M_z between the core and the materal adhering to the roller 71. Therefore, the two blasts of the nozzles 103 and 105 facilitate the breakdown and the winding of the end of the material on the newly inserted core.

If the acceleration of the roller 97 and the simultaneous slowing down of the cylinder 73 do not cause the tearing and thus the separation of the material web from the reel now formed, then gradually the thrust of the blast generated by the nozzle 103 determines the forming of a loop of material which is inserted between the core and the cylinder 73; the seizing of the loop by the cylinder 73, which entrains it in the direction of the arrow f_{14}, leads to tearing of the material strip.

After the removal of the completed reel, the roller 97 is lowered again and is arranged to contact the newly inserted tubular core onto which the material has been wound and which moves from the position B_{10} to the position B_{12} to continue with the winding of the material.

The arrangement of Figs. 10 and 12 simplifies the provision of the nozzles 103 and 105 (with a continuous slit or not) and the passage of the material through the device is simpler than in the embodiment of Figs. 1 to 9. Also, the cylinders 71 and 73 are both provided with a uniform cylindrical surface, without any annular grooves, this being advantageous for the uniformity and regularity of the forming of the reels.

WHAT I CLAIM IS:—

1. A device for continuous winding of a paper web into rolls, such as toilet paper or the like, including a first cylinder adapted to be driven at a peripheral speed equal to the feed speed of the web to be wound; a second cylinder spaced from the first cylinder by an amount corresponding to the diameter of the winding cores onto which the webs can be wound, said second cylinder being adapted to be driven at a peripheral speed equal to that of the first cylinder during winding of the webs into rolls, and at a lower speed during the core replacement stage; means to insert a core between said two cylinders, a roller adapted to rotate in contact with the roll being wound so as to retain the same in contact with the first and second cylinder and means for driving the said roller during the separation stage of the completed roll at a peripheral speed different from the feed speed to cause the com-

pleted roll to roll on one of the cylinders and separate from the other.

2. A device as claimed in Claim 1, characterized in that said roller is slowed down or stopped during the separation stage.

3. A device as claimed in claims 1 and 2, characterized in that the first cylinder is provided with annular grooves accommodating belt conveyors for the completed roll; said conveyors being arranged to pick up the completed roll from the first cylinder after it has been separated from the second cylinder by the slowing of the roller.

4. A device as claimed in claim 3, in which a guide surface is arranged parallel to and spaced from said conveyors, which operate at a speed reduced with respect to feed speed.

5. A device as claimed in Claims 3 or 4, characterized in that, in combination with the conveyors, pneumatic nozzles are provided to act on a loop formed between the completed roll and the new core inserted between the first and second cylinders to initiate winding of the loop on said new core and also the tearing of the material.

6. A device as claimed in Claim 5, in which the nozzles are accommodated in the groove of the first cylinder.

7. A device as claimed in any of Claims 1 to 6, characterized in that the means to insert a core include a thrust means having a thrust surface inclined so as to stress the core towards the first cylinder.

8. A device as claimed in Claim 1, characterized in that the roller is accelerated during the separation stage, and that blowing means are provided at least between one of the cylinders and the roller.

9. A device as claimed in Claim 8, characterized in that the first cylinder overlies the second cylinder and is spaced therefrom by an amount corresponding to the diameter of a tubular core.

10. A device as claimed in Claim 8, characterized in that an assembly of nozzles is provided between the first cylinder and the movable roller to blow downwards and urge an end of the web between the tubular core just inserted and the second cylinder to begin the winding.

11. A device as claimed in Claim 10, characterized in that a further assembly of nozzles is provided to act between the first cylinder and the newly inserted tubular core, to aid the initial winding thereon.

12. A device as claimed in any of Claims 8 to 11, characterized in that a rolling surface is provided adjacent the zone of the second cylinder and the movable roller.

13. A device for continuous winding of a paper web into rolls substantially as above described and as illustrated in the accompanying drawings.

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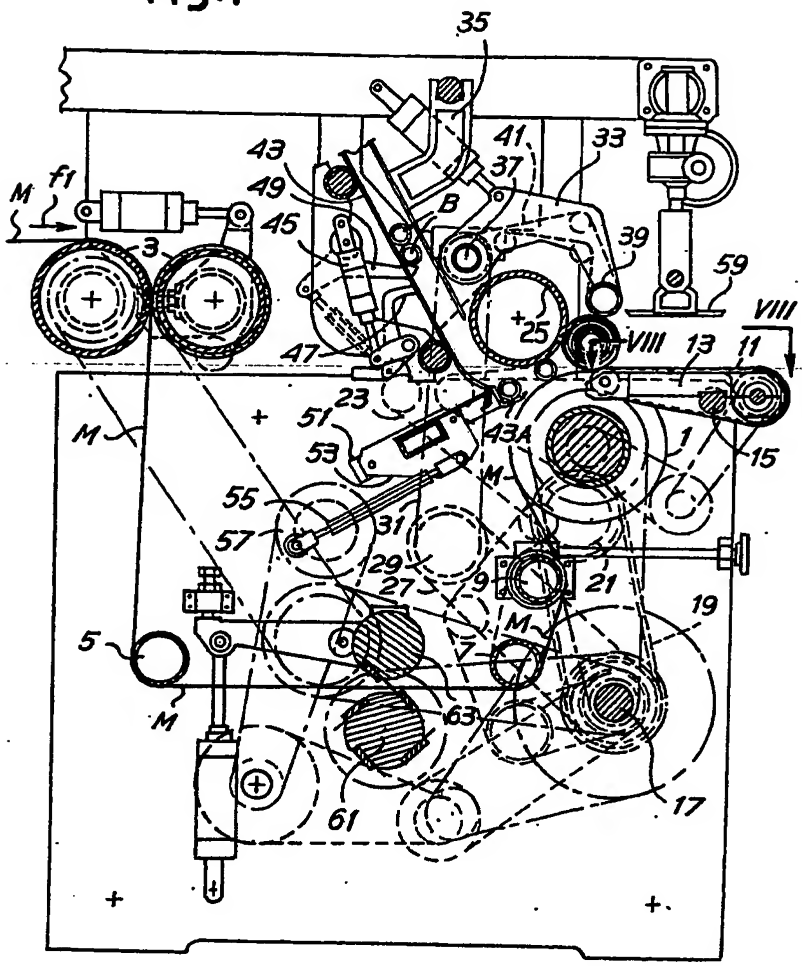
Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1976.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

Fig.1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43A
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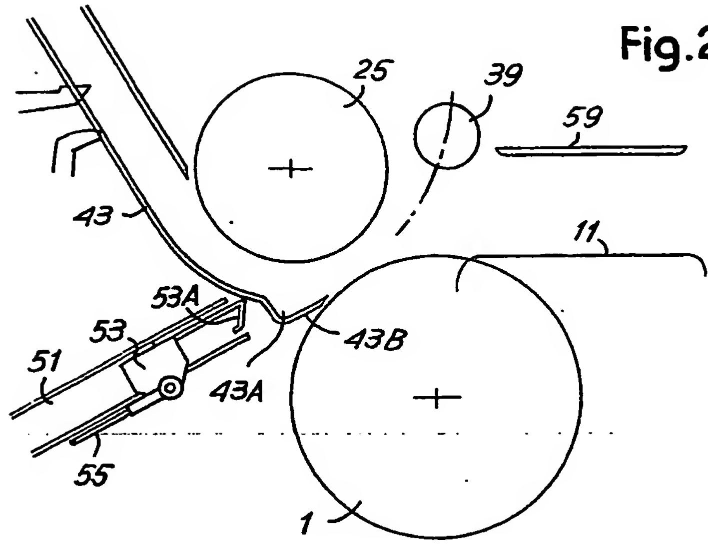
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Fig.2

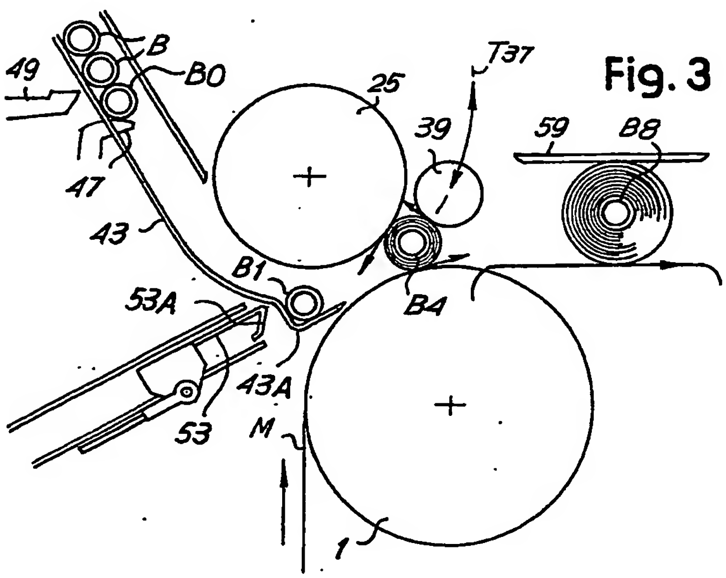
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Fig. 3

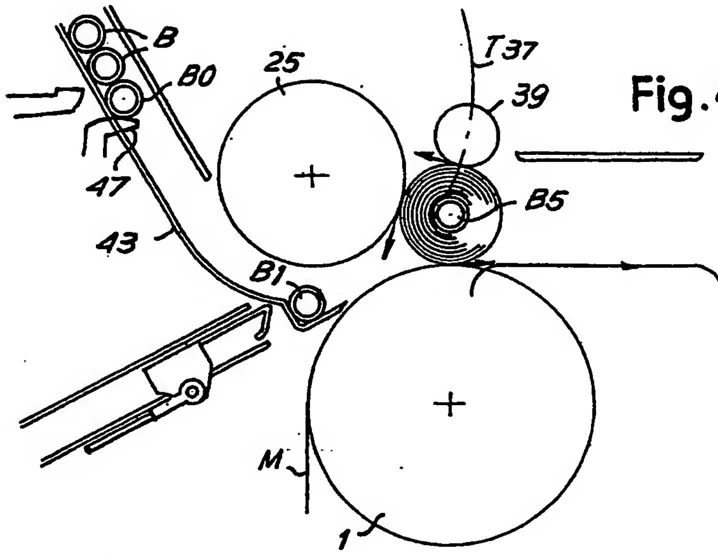


Fig. 4

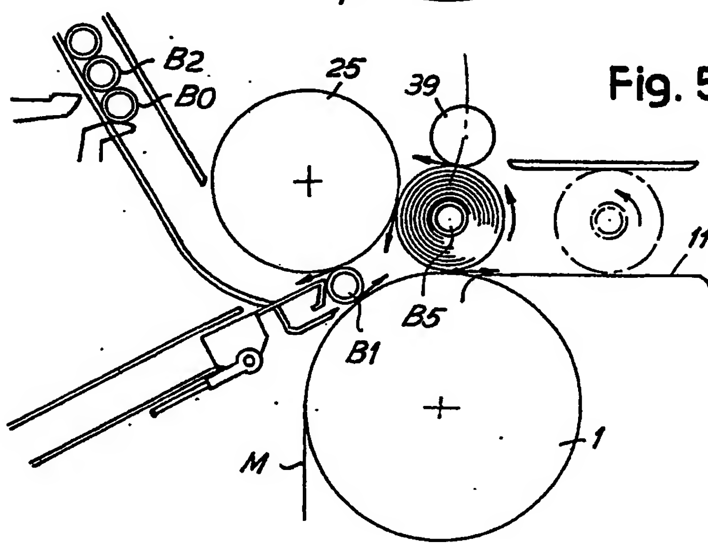


Fig. 5

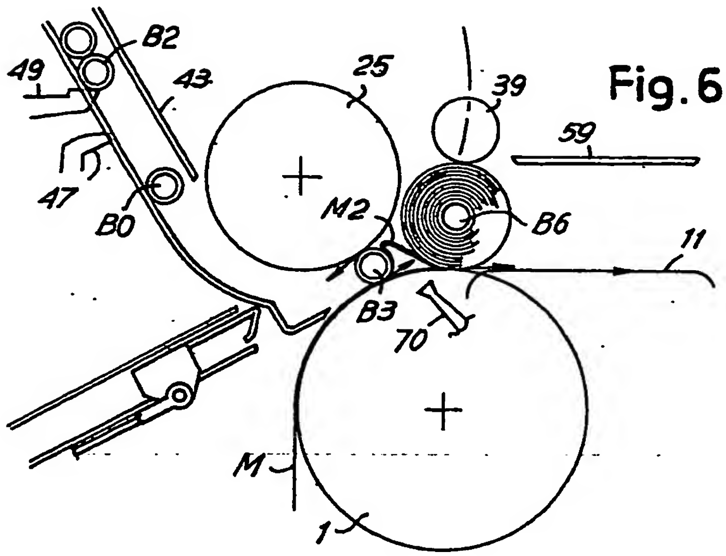


Fig. 6

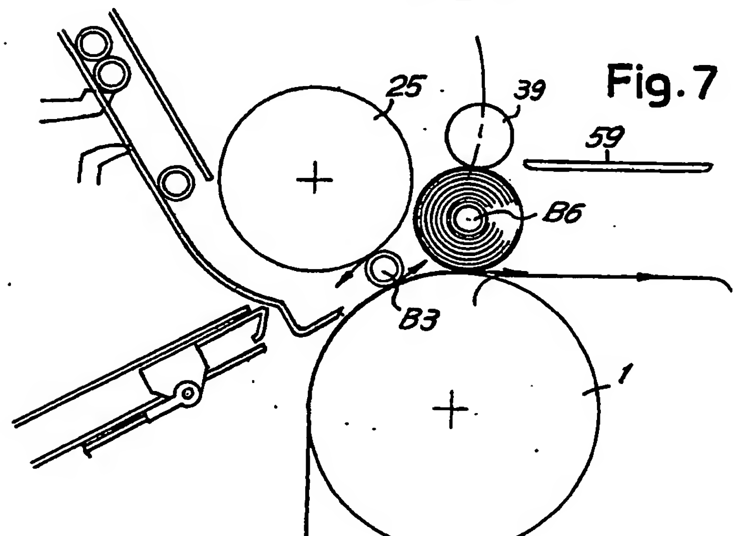


Fig. 7

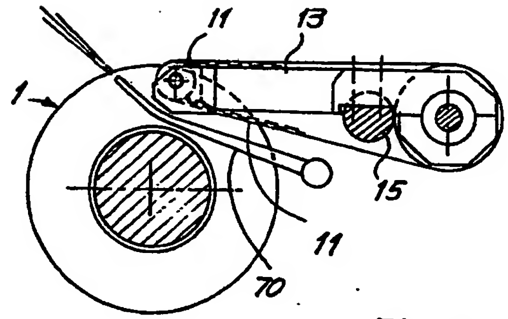


Fig.9

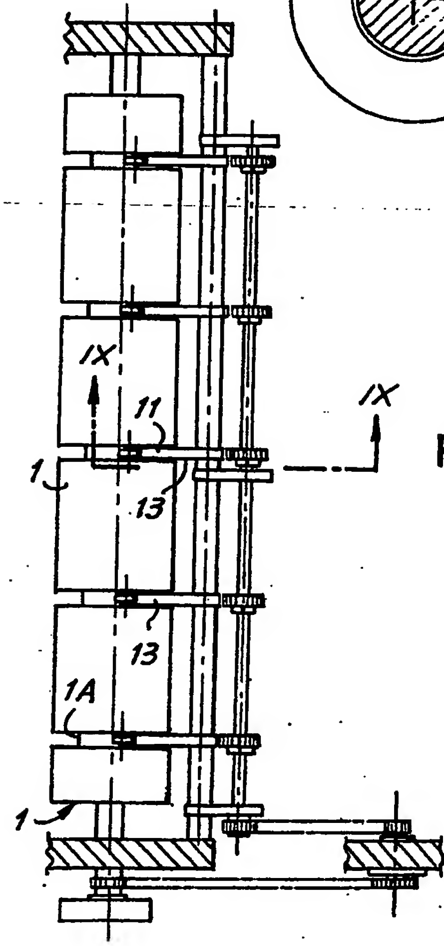


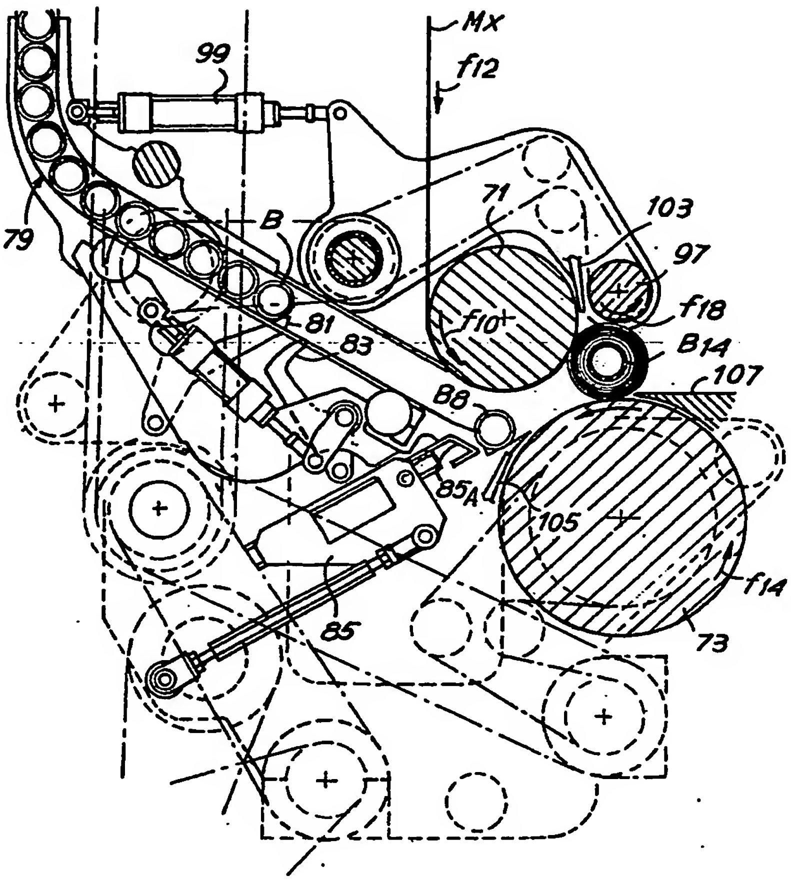
Fig. 8

1435525 COMPLETE SPECIFICATION

7 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 6

Fig. 10



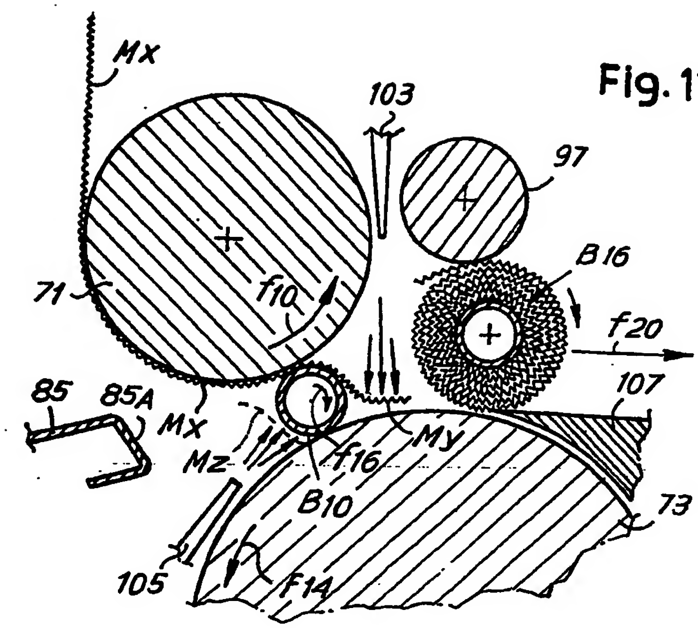

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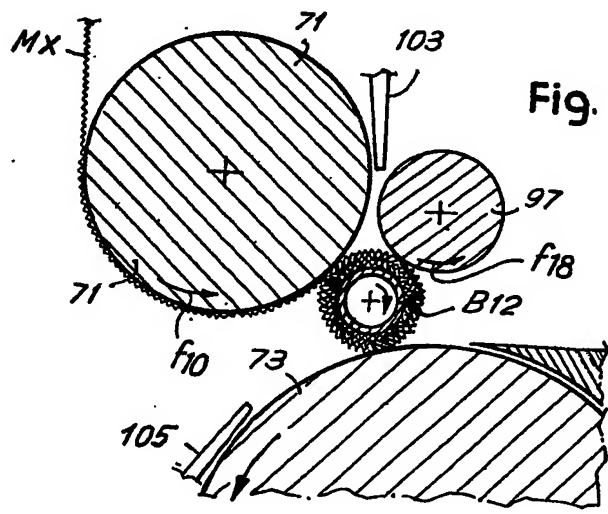
Fig. 11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103
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Fig. 12